Exhibit H

United States Government Accountability Office

Report to Congressional Requesters

August 2014

OIL AND GAS TRANSPORTATION

Department of Transportation Is Taking Actions to Address Rail Safety, but Additional Actions Are Needed to Improve Pipeline Safety

GAO-14-667

GAO Highlights

Highlights of GAO-14-667, a report to congressional requesters

August 2014

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Why GAO Did This Study

Technology advancements such as horizontal drilling and hydraulic fracturing (pumping water, sand, and chemicals into wells to fracture underground rock formations and allow oil or gas to flow) have allowed companies to extract oil and gas from shale and other tight geological formations. As a result, oil and gas production has increased more than fivefold from 2007 through 2012. DOT oversees the safety of the U.S. transportation system.

GAO was asked to review oil and gas transportation infrastructure issues. This report examines (1) overall challenges that increased oil and gas production may pose for transportation infrastructure, (2) specific pipeline safety risks and how DOT is addressing them, and (3) specific rail safety risks and how DOT is addressing them. GAO analyzed federal transportation infrastructure and safety data generally from 2008 to 2012 or 2013 (as available), reviewed documents, and interviewed agency, industry, and safety stakeholders, as well as state and industry officials in states with large-scale shale oil and gas development.

What GAO Recommends

DOT should move forward with a proposed rulemaking to address safety risks—including emergency response planning—from newer gathering pipelines. DOT generally concurred with the recommendation and stated that it is developing a rulemaking to revise its pipeline safety regulations.

View GAO-14-667. For more information, contact Susan Fleming at (202) 512-2834 or flemings@gao.gov or Frank Rusco at (202) 512-3841 or ruscof@gao.gov.

What GAO Found

Increased oil and gas production presents challenges for transportation infrastructure because some of this increase is in areas with limited transportation linkages. For example, insufficient pipeline capacity to transport crude oil has resulted in the increased use of rail, truck, and barge to move oil to refineries, according to government and industry studies and publications GAO reviewed. These transportation limitations and related effects could pose environmental risks and have economic implications. For instance, natural gas produced as a byproduct of oil is burned—a process called flaring—by operators due, in part, to insufficient pipelines in production areas. In a 2012 report, GAO found that flaring poses a risk to air quality as it emits carbon dioxide, a greenhouse gas linked to climate change, and other air pollutants. In addition, flaring results in the loss of a valuable resource and royalty revenue.

Due to the increased oil and gas production, construction of larger, higher-pressure gathering pipelines (pipelines that transport products to processing facilities and other long-distance pipelines) has increased. However, these pipelines, if located in rural areas, are generally not subject to U.S. Department of Transportation (DOT) safety regulations that apply to other pipelines, including emergency response requirements. Historically, gathering pipelines were smaller and operated at lower pressure and thus posed less risk than long-distance pipelines. But the recent increase in their size and pressure raises safety concerns because they could affect a greater area in the event of an incident. In 2011, DOT began a regulatory proceeding to address the safety risks of gathering pipelines, but it has not proposed new regulations. Although states may regulate gathering pipelines, an association of state pipeline regulators' report on state pipeline oversight shows that most states do not currently regulate gathering pipelines in rural areas.

Crude oil carloads moved by rail in 2012 increased by 24 times over that moved in 2008. Such an increase raises specific concerns about testing and packaging of crude oil, use of unit trains (trains of about 80 to 120 crude oil cars), and emergency response preparedness. Crude oil shippers are required to identify their product's hazardous properties, including flammability, before packaging the oil in an authorized tank car. DOT has issued safety alerts on the importance of proper testing and packaging of crude oil. However, industry stakeholders said that DOT's guidance on this issue is vague and that clarity about the type and frequency of testing is needed. In July 2014, DOT proposed new regulations for crude oil shippers to develop a product-testing program subject to DOT's review. Additionally, unit trains, which can carry 3 million or more gallons of crude oil and travel to various locations through the country, are not covered under DOT's comprehensive emergency response planning requirements for transporting crude oil by rail because the requirements currently only apply to individual tank cars and not unit trains. This raises concerns about the adequacy of emergency response preparedness, especially in rural areas where there may be fewer resources to respond to a serious incident. Also in July 2014, DOT sought public comment on potential options for addressing this gap in emergency response planning requirements for transporting crude oil by rail.

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Abbreviations

AAR	Association of American Railroads
DOT	Department of Transportation
EIA	Energy Information Administration
FRA	Federal Railroad Administration
INGAA	Interstate Natural Gas Association of America
LNG	liquefied natural gas
Mcf	thousand cubic feet
MMBtu	million British thermal units
NOx	nitrogen oxides
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
PSI	pounds per square inch
STB	Surface Transportation Board
Tcf	trillion cubic feet

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The Honorable John D. Rockefeller, IV
Chairman
The Honorable John Thune
Ranking Member
Committee on Commerce, Science, and Transportation
United States Senate

The Honorable Ron Wyden
United States Senate

U.S. production of oil and gas resources has increased in recent years, driven in part by improvements in technologies. Oil and gas resources contained in underground shale formations were previously considered to be inaccessible because traditional techniques did not yield sufficient amounts for economically viable production. The application of horizontal drilling techniques and hydraulic fracturing—a process that injects a combination of water, sand, and chemical additives under high pressure to create and maintain fractures in underground rock formations that allow oil and natural gas to flow—have increased U.S. crude oil and natural gas production dramatically.

This rapid expansion of domestic oil and gas production has also changed dynamics for transporting these products to the market and has raised questions about safety. While pipelines transport the majority of oil and gas in the United States, recent development of crude oil in parts of the country underserved by pipeline has led shippers to use other modes, with rail seeing the largest percentage increase. Although pipeline operators and railroads have generally good safety records, the increased transportation of these flammable hazardous materials creates the potential for serious incidents. The explosion and fire caused by the July 2013 derailment of a crude oil train in Lac-Mégantic, Quebec killed 47 people and extensively damaged the city's downtown area, highlighting the consequences that may result from such incidents. The U.S. Department of Transportation (DOT) is responsible for ensuring the safety of the U.S. transportation system, including protecting people and the environment from the risks of transporting hazardous materials by pipeline, rail, and other modes. In particular, DOT's Pipeline and Hazardous Materials Safety Administration (PHMSA) has responsibility for pipeline safety oversight as well as hazardous materials transportation safety oversight for other transportation modes, including rail.

You requested that we examine the impact of shale oil and gas development on transportation infrastructure and safety. We are providing a broad overview of transportation infrastructure impacts and a closer look at the infrastructure changes and associated safety issues with pipeline and rail.[1] Specifically, this report addresses:

(1) challenges, if any, that increased domestic oil and gas production poses for U.S. transportation infrastructure and examples of associated risks and implications;

(2) how pipeline infrastructure has changed as a result of increased oil and gas production, the key related safety risks, and to what extent DOT has addressed these risks; and

(3) how rail infrastructure has changed as a result of increased oil production, the key related safety risks, and to what extent DOT has addressed these risks.

To identify challenges increased domestic oil and gas production poses for U.S. transportation infrastructure and the associated implications, we reviewed and synthesized information from studies and other publications from federal, state, and tribal government agencies; industry; academics; and other organizations. We identified these studies and publications by conducting a search of web-based databases and other resources containing general academic articles, government resources, and "gray literature."[2] We believe the studies and publications identified through our literature search provide key examples of transportation infrastructure limitations and associated implications. In addition, we analyzed data from the U.S. Department of Energy's Energy Information Administration (EIA) on oil and gas produced from 2007 to 2012. To assess the reliability of these data, we examined EIA's published methodology for collecting

[1]We focused our work on pipeline and rail because pipeline is the most used mode for transporting oil and gas products and rail has seen the largest percentage increase in use in recent years.

[2]"Gray literature" publications may include, but are not limited to, the following types of materials: reports (pre-prints, preliminary progress and advanced reports, technical reports, statistical reports, memorandums, state-of-the art reports, market research reports, etc.); theses; conference proceedings; technical specifications and standards; non-commercial translations; bibliographies; technical and commercial documentation; and official documents not published commercially (primarily government reports and documents).

this information and found the data sufficiently reliable for the purposes of this report.

To determine how pipeline infrastructure has changed as a result of increased oil and gas production, we analyzed PHMSA data on pipeline construction from January 1, 2010 through December 31, 2012 and interviewed DOT officials and industry representatives, including pipeline operators. To determine how rail infrastructure has changed, we analyzed the Surface Transportation Board's (STB) data for calendar years 2008 through 2012 on crude oil shipments by rail and interviewed DOT officials and industry representatives, including railroads. To identify the key safety risks related to changes in pipeline and rail infrastructure, we analyzed PHMSA data from January 1, 2008 through December 31, 2013 on pipeline and rail incidents, reviewed documents submitted as part of DOT's rulemaking on rail safety, and interviewed DOT officials and representatives from safety organizations, emergency responder associations, and industry. We assessed the reliability of PHMSA's data on pipeline construction and pipeline and rail incidents and STB's data on crude oil shipments by rail by reviewing documentation about the data sources, interviewing agency officials about how the data were collected, and reviewing related internal controls. We also reviewed some of the data for potential inconsistencies through testing and comparing the data to publicly available sources of similar information. We concluded that these data were sufficiently reliable for the purposes used in our report. Additionally, to examine infrastructure impacts and safety risks closely associated with transporting shale oil and gas, we interviewed officials and reviewed related documents from state oil and gas safety regulatory agencies, transportation departments, industry associations and oil and gas transportation companies (such as pipeline operators, railroads, and operators of rail loading terminals) in four states: North Dakota, Pennsylvania, Texas, and West Virginia. We selected these states because of their significant shale oil and gas development and varying geographic locations. To evaluate to what extent DOT has addressed safety risks, we reviewed federal laws and regulations and DOT emergency orders and guidance, interviewed DOT officials, and compared DOT's actions against risk-based management principles. See appendix I for a more detailed description of our objectives, scope, and methodology.

We conducted this performance audit from August 2013 to August 2014 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our

findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

Location of Oil and Gas Development in the United States

Oil and natural gas are found in a variety of geologic formations distributed across the country, such as shale and tight sandstone.[3] Shale plays—sets of discovered or undiscovered oil and natural gas accumulations or prospects that exhibit similar geological characteristics—are located within basins, which are large-scale geological depressions, often hundreds of miles across, that also may contain other oil and gas resources. Figure 1 shows the location of shale plays and basins in the contiguous 48 states.

[3]Shale is a sedimentary rock that is predominantly composed of consolidated clay-sized particles.

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Congressional Research Service report states that significant development of loading and unloading facilities could be required if rail is to continue substituting for pipeline capacity.[31] Further, a number of studies and publications identified that oil and gas production in some areas can exceed the capacity to process and store the resources.[32] For example, state officials in North Dakota reported in 2013 that maintaining sufficient natural gas processing capacity is a challenge of increased production.

Transportation Infrastructure Limitations and Related Effects Could Pose Environmental and Safety Risks and Have Economic Implications

A number of studies and publications we reviewed identified environmental and safety risks or economic implications from transportation infrastructure limitations. For example:

Risks to air quality: These risks can be the result of intentional flaring—a process of burning the gas developed along with oil—of associated natural gas that results from limited pipeline infrastructure and of engine exhaust from increased truck and rail traffic.

Oil and natural gas are often found together in the same reservoir. The natural gas produced from oil wells is generally classified as "associated-dissolved," meaning that it is associated with or dissolved in crude oil. In areas where the primary purpose of drilling is to produce oil, operators may flare associated natural gas because no local market exists for the gas and transporting to a market may not be economically feasible. In September 2012, we found that flaring poses a risk to air quality because it emits carbon dioxide—a greenhouse gas linked to climate change—and other air pollutants that can increase ground-level ozone levels and contribute to regional haze.[33] In January 2014, the North Dakota Industrial Commission reported that nearly 30 percent of all natural gas produced in the state is flared. According to a 2013 report from Ceres, flaring in North

[31]Congressional Research Service, *U.S. Rail Transportation of Crude Oil: Background and Issues for Congress,* R43390 (Washington, D.C.: Feb. 6, 2014).

[32]For example, Nick Snow, "Massive investment needed for oil, gas facilities, experts say," *Oil and Gas Journal* (May 28, 2012) and Ceres, *Flaring Up: North Dakota Natural Gas Flaring More Than Doubles in Two Years* (July 2013). Ceres is a nonprofit organization.

[33]GAO-12-732.

Dakota in 2012 resulted in greenhouse gas emissions equivalent to adding 1 million cars to the road.[34]

Increased truck and rail traffic associated with the movement of oil from well sites also creates a risk to air quality as engine exhaust, containing air pollutants such as nitrogen oxides and particulate matter that affect public health and the environment is released into the atmosphere.[35] Specifically, the Department of State reported in 2014 that increasing the number of unit trains transporting crude oil could increase greenhouse gases emitted directly from the combustion of diesel fuel in trains[36] and in 2011 we found that trucking freight produces more air pollution than other transportation modes.[37] Air quality may also be degraded as fleets of trucks traveling on newly graded or unpaved roads increase the amount of dust released into the air—which can contribute to the formation of regional haze.[38]

Inherent safety risks: Transporting oil and gas by any means—through pipelines, rail, truck, or barge—poses inherent safety risks. However, in January 2013, we found that pipelines are relatively safe when compared with other modes, such as rail and truck, for transporting hazardous goods because pipelines are mostly underground.[39] For example, we

[34]Ceres, *Flaring Up: North Dakota Natural Gas Flaring More Than Doubles in Two Years* (July 2013).

[35]Nitrogen oxides are regulated pollutants commonly known as NOx that, among other things, contribute to the formation of ozone and have been linked to respiratory illness, decreased lung function, and premature death. Particulate matter is a ubiquitous form of air pollution commonly referred to as soot. GAO, *Diesel Pollution: Fragmented Federal Programs That Reduce Mobile Source Emissions Could Be Improved*, GAO-12-261 (Washington, D.C.: Feb. 7, 2012).

[36]According to the Department of State's Final Environmental Impact Statement for the Keystone XL Pipeline, the use of liquefied natural gas (LNG) as a fuel source for trains is being developed and tested. The use of LNG could reduce greenhouse gas emissions compared to the use of diesel fuel.

[37]GAO, *Surface Freight Transportation: A Comparison of the Costs of Road, Rail, and Waterways Freight Shipments That Are Not Passed on to Consumers*, GAO-11-134 (Washington, D.C.: Jan. 26, 2011).

[38]T. Colborn, C. Kwiatkowski, K. Schultz, and M. Bachran, "Natural Gas Operations From a Public Health Perspective," *International Journal of Human & Ecological Risk Assessment* 17, no. 5 (2011).

[39]GAO, *Pipeline Safety: Better Data and Guidance Needed to Improve Pipeline Operator Incident Response*, GAO-13-168 (Washington, D.C.: Jan. 23, 2013).

found that large trucks and rail cars transporting hazardous materials, including crude oil and natural gas liquids, resulted in far more fatalities and incidents than pipelines. Specifically, we found that from 2007 to 2011, fatalities averaged about 14 per year for all pipeline incidents reported to PHMSA, including an average of about 2 fatalities per year resulting from incidents on hazardous liquid and natural gas transmission pipelines.[40] In comparison, in 2010, 3,675 fatalities resulted from incidents involving large trucks and 730 additional fatalities resulted from railroad incidents. Therefore, increased transport of oil and gas by rail, truck, or barge could increase safety risks.

According to state officials and several publications we reviewed, increased truck traffic resulting from increased oil and gas production can present hazardous driving conditions—particularly on roads not designed to handle heavy truck traffic.[41] Our analysis of data from PHMSA found that in recent years, the number of reported incidents involving the transport of crude oil by truck in both Texas and North Dakota has increased. Specifically, such incidents increased in Texas from 17 incidents in 2008 to 70 incidents in 2013, and in North Dakota they increased from 1 incident in 2008 to 16 incidents in 2013.

Barge accidents also pose safety risks and can have associated environmental and economic effects. For example, according to the U.S. Coast Guard Polluting Incident Compendium, in 2011, a barge struck a bridge on the Lower Mississippi River causing damage to the barge and a discharge of just over 11,000 gallons of oil.[42] In February 2014, a barge crash resulted in the spilling of about 31,500 gallons of crude oil into the Mississippi River, temporarily shutting down transportation along the river. According to a 2012 Congressional Research Service report, an oil spill from a barge can cause significant harm to marine ecosystems and

[40]More recently, we analyzed PHMSA's pipeline incident data for 2008 through 2013 and found that there was an average of about 3 fatalities per year from incidents involving natural gas pipelines and hazardous liquid pipelines that carry crude oil. Of the 17 reported fatalities during that time, 8 were attributed to a natural gas pipeline incident in 2010.

[41]For example, testimony of Dana "Sam" Buckles Tribal Executive Board Member Assiniboine and Sioux Tribes of the Fort Peck Reservation before the Senate Committee On Indian Affairs Oversight hearing on Tribal Transportation: Pathways to Infrastructure and Economic Development in Indian Country, 113th Cong., 2nd sess., March 13, 2014.

[42]U.S. Coast Guard, *Polluting Incident Compendium Part II* (December 2012).

individual aquatic organisms and negatively affect business activity near the spill, particularly businesses and individuals that count on the resources and reputation of the local environment.[43] For instance, the local fishing and tourist industry may be affected, and in some cases, a well-publicized oil spill can weaken local or regional industries near the spill site, regardless of the actual threat to human health created by the spill.

Economic implications: According to a number of studies and publications we reviewed, infrastructure limitations and related effects could have economic implications, including lost revenue, higher energy prices, and hindered development.

- ***Lost revenue:*** In addition to the risks to air quality from flaring, we found in October 2010 that flaring natural gas has economic implications,[44] and in April 2014 the Environmental Protection Agency reported that flaring results in the destruction of a valuable resource.[45] For example, in 2010 we found that on federal oil and gas leases, natural gas that is flared, instead of captured for sale, represents a loss of about $23 million annually in royalty revenue for the federal government. According to a 2013 report from the North Dakota Pipeline Authority, in August 2013, 2.7 percent of the total economic value and 7.2 percent of the total energy content being produced in North Dakota were lost due to flaring.[46] In another example, a Ceres report found that in May 2013 roughly $3.6 million of revenue was lost per day, at market rates, as a result of flaring in North Dakota.[47]

[43]Congressional Research Service, *Oil Spills in U.S. Coastal Waters: Background and Governance*, RL33705 (Washington, D.C.: Jan. 11, 2012).

[44]GAO, *Federal Oil and Gas Leases: Opportunities Exist to Capture Vented and Flared Natural Gas, Which Would Increase Royalty Payments and Reduce Greenhouse Gases*, GAO-11-34 (Washington, D.C.: Oct. 29, 2010).

[45]Environmental Protection Agency, *Oil and Natural Gas Sector Hydraulically Fractured Oil Well Completions and Associated Gas During Ongoing Production*, (April 2014).

[46]North Dakota Pipeline Authority, "North Dakota Natural Gas: A Detailed Look at Natural Gas Gathering," Oct. 21, 2013.

[47]Ceres, *Flaring Up: North Dakota Natural Gas Flaring More Than Doubles in Two Years* (July 2013).

- ***Higher energy prices:*** Growing shale development and the resulting increased availability and lower prices of natural gas have contributed to an increasing reliance on natural gas as a source of producing electricity in some parts of the country. However, pipeline infrastructure limitations have at times contributed to price spikes. For example, according to a paper from ICF International, pipeline limitations were a contributing factor to higher natural gas prices in the northeast in January 2014.[48] A cold weather pattern involving record low temperatures led to increased demand for natural gas for space heating and for generating electricity across parts of the country. With the surge in demand, several major pipeline systems became constrained and could not deliver sufficient natural gas to meet demand. According to a 2014 EIA publication, prices at the Algonquin, Massachusetts trading point, which normally are around $3 to $6 per million British thermal units (MMBtu) during unconstrained periods, reached up to $38/MMBtu in early January.[49] These price increases for natural gas led electricity systems to use more oil-fueled generating resources during this period.

- ***Hindered oil and gas production:*** A 2013 study sponsored in part by the Utah Department of Transportation found that oil and gas production from the Uinta Basin is likely to be constrained by limitations in the capacity of transportation infrastructure. Specifically, the study found that existing pipelines in the state are already at or near capacity, and by 2020, demand on the infrastructure network to transport oil and gas will exceed capacity—resulting in a loss of 12 percent of potential production over the next 30 years.[50] Further, according to a 2013 industry report, infrastructure constraints such as pipeline limitations and bottlenecks from the Permian Basin in Texas to a key hub have contributed to discounted prices for some domestic crude oils.[51] For example, we found in March 2014 that West Texas

[48]ICF International is a consulting firm that provides information to public- and private-sector clients.

[49]EIA, *Northeast and Mid-Atlantic power prices react to winter freeze and natural gas constraints* (Jan. 21, 2014).

[50]Duchesne County, Uintah County, Uintah Transportation Special Service District, and the Utah Department of Transportation, *Final Report: Uinta Basin Energy and Transportation Study,* Project No. S-LC47 (14) (Salt Lake City, Utah: April 2013).

[51]John R. Auers and John Mayes, "North American Production Boom Pushes Crude Blending," *Oil and Gas Journal* (May 6, 2013).